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Trade and Growth in Ecuador

A Partial Equilibrium View

Jesko Hentschel

A deterioration of the terms of trade or a decline in world demand has a pronounced negative impact on Ecuador's trade balance and thus threatens growth if external financing cannot be obtained. This vulnerability stems in part from low substitution elasticities for imported factors of production. Policies that lead to a diversification of exports and higher price responsiveness for both imports and exports would reduce the vulnerability of Ecuador's economy to external shocks.

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Summary findings

When the outbreak of the debt crisis in 1982 halted private international capital flows to most developing countries, it was not easy for Ecuador to cope with the changed international circumstances. Investments were largely in imported machinery as domestic capital goods production was in its infancy. Exports were concentrated in petroleum and several agricultural products and could not be counted on to increase foreign exchange in the short run. The trade balance was improved in the first half of the 1980s by reducing imports.

Hentschel examines the behavior of the Ecuadoran economy in a period of scarce foreign exchange.

He uses a small, econometrically specified "trade and growth" model of the Ecuadoran economy to illustrate the importance of trade elasticities. He estimates trade elasticities for Ecuador and integrates them into a small simulation model of Ecuador's supply side. He uses a nested constant-elasticity-of-substitution production function to derive factor input demands for two types of imported goods important in Ecuador: imported intermediate goods and imported machinery.

Elasticity estimates of imported factors of production are very low. They characterize both types of imports as complements to domestic factors.

Hentschel uses the econometrically specified model to examine the connection between imported factors of production and output capacity. He analyzes trade balance responses to a terms-of-trade shock, a devaluation, and an increase in world demand.

Low trade elasticities on the import side make the economy vulnerable to external shocks. The low elasticities necessitate large relative price shifts (through devaluations) to improve the trade balance if growth-reducing policies are to be avoided in times of scarce foreign exchange.

A deterioration in terms of trade has a pronounced negative impact on the trade balance. To the extent that trade elasticities remain low in the 1990s, events such as a commodity price decline, a renewed credit squeeze, or increased protectionism against Ecuadoran exports — like the recent European Union quotas on banana imports — can translate into renewed domestic supply disturbances.

Policies that lead to a diversification of exports and higher price responsiveness for both imports and exports would reduce the vulnerability of Ecuador's economy to external shocks.

This paper — a product of the Country Operations 1 Division, Latin America and the Caribbean, Country Department III — is part of a larger effort in the region to understand the linkages between trade and growth in Latin American countries. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Dorothy Jenkins, room I5-057, extension 37890 (16 pages). August 1994.

Trade and Growth in Ecuador - A Partial Equilibrium View[1]

Jesko Hentschel

1. Introduction

When the outbreak of the debt crisis halted private international capital flows to most developing countries in 1982, Ecuador was not in an easy position to cope with the changed international circumstances. Foreign savings had been relied on heavily to finance capital formation during the late 1970s. Investments consisted largely of imported machinery as domestic capital goods production was in its infancy. Further, Ecuador's exports were concentrated in petroleum and several agricultural products and exports could not be relied on to increase foreign exchange availability. Instead, trade balance improvements in the first half of the 1980s were achieved by a reduction in imports.

This paper examines the behavior of the Ecuadoran economy in a period of scarce foreign exchange. Parameters of significant importance in this context are the trade elasticities which determine to what extent relative price changes can be relied on to achieve trade balance improvements.

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1 This paper is partly based on my PhD dissertation at the University of Konstanz (Hentschel 1992).

A small, econometrically specified 'trade and growth' model of the Ecuadoran economy is used to illustrate the importance of these trade elasticities. In the approach presented here, we derive factor input demands for two types of imported goods -- capital and intermediate -- from a nested Constant-Elasticity-of-Substitution production function. Export elasticities are determined from a simultaneous estimation of supply and demand. We simulate the reaction of the trade balance to a devaluation, a terms-or-trade shock and a sudden upward shift in the demand for exports. A 'growth - trade balance' curve is computed from the model which allows us to compare trade balance reactions for various growth scenarios.

The model is of a partial equilibrium nature with focus on the links between disaggregate imports and growth.[2] The model only incorporates the supply side and does neither include demand or the financial sector. As we assume a one-good-economy, investment is purely a function of relative prices. Other important variables determining investment behavior -- such as expected levels of inflation, overall macroeconomic stability or portfolio decisions of the economic agents -- are omitted. The above restrictions limit the applicability of the results. The model is useful, however, in highlighting the importance of structural rigidities for the design of macroeconomic adjustment policies.

The next section provides a short background on the economic situation of Ecuador at the beginning of the 1980s. Section 3 introduces the model and presents estimation results for the most important parameters. Based on the econometric specification, we simulate the reaction of the trade balance in various scenarios. The last section offers some concluding remarks.

2. Background

The oil boom of the 1970s turned Ecuador from a poor, primary-export dependent economy into a middle-income country with a stock of wealth in the form of oil reserves. But while the growth of the economy was oil-led at the beginning of the decade, it became largely debt-led in the second half. Growth of petroleum exports came to a stand-still towards the end of the 1970s while imports mushroomed.

An industrialization strategy behind highly protective barriers had been started during the 1970s, leading to a capital-intensive industry which produced inefficiently when compared internationally. The protection structure and an overvalued exchange rate created incentives to use imported capital goods intensively for investments and it biased production in the manufacturing sector (16% of GDP in 1982) towards consumption and intermediate goods. Domestic capital goods production was in its

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2 The motivation of the model is hence similar to import compression models, e.g. the one by Khan and Knight (1988).

infancy and concentrated in low-technology intensive processes. Consequently, Ecuador imported more than two-thirds of installed machinery in the years before the debt crisis started (see Table 1). Imported industrial intermediate goods also constituted a major supply of this product category. Imports of consumer goods made up hardly 10% of the total import bill, leaving very little leeway to restructure import expenditures in favor of productive factors in times of foreign exchange scarcity.

Exports were highly concentrated in oil, bananas and coffee. The undiversified export base can be partly explained by the high discrimination against non-traditional exports which resulted from the high protection of domestic consumer goods industries and a strong appreciation of the Sucre accompanying the capital inflows and the oil-boom in the 1970s. Exports were relied on to finance necessary imports of capital and technology-intensive intermediate inputs. Domestic production was dominated by the nontradables sector -- it accounted for 58% of domestic value added in 1981.[3]

Table 1: Trade structure and indicators of import intensity of domestic production before the debt crisis, 1979-1981

Composition of imports	
- capital goods	39%
- intermediate goods	51%
- consumer goods	10%
Composition of exports	
- petroleum and petr. products	62%
- bananas	9%
- coffee	8%
- other food articles	14%
Share of imported capital goods in installment of machinery	70%
Share of imported industrial raw materials in manufacturing output	3%
Share of imported industrial intermediate goods in apparent consumption of this product category	31%

Source: Calculations from UNCTAD, UNIDO, World Bank (see Annex).

3 Janvry et al. (1991), p. 25.

The high current account deficits of 1981 and 1982 (15% and 18% of GDP, respectively) were not sustainable with the sharply reduced flow of private capital. A major improvement of the trade and current account was achieved but this forced adjustment fell almost entirely on imports. While export proceeds stagnated in 1983 and 1984 - although export taxes were lowered substantially -, import expenditures decreased by almost 40% compared to their 1981 level. This reduction of imports was partly due to a sharp increase in protective measures such as tariff increases and applications of quantitative restrictions. Further, large devaluations of the Sucre changed the relative price between imported and domestically produced goods. To what degree these changing relative prices were effective in affecting trade flows is explored below.

3. Structure of the model and estimation results

We analyze the linkages between domestic growth and merchandise trade in Ecuador in a partial equilibrium framework. Concentration lies on the supply-side of the economy, while aggregate demand and its determinants are not explored. The model captures only the real goods sector and leaves financial transactions and the monetary sector aside. Therefore, the output of the economy has to be viewed as 'potential' or 'capacity' production instead of being 'actual' output.

The structure of the model is presented in Box 1. A one-sector economy is assumed. Output is a function of four factors of production: imported inputs, labor, a 'domestic' capital stock and an 'imported' capital stock. A three-level nested production function is introduced. As depicted in equation 1, output of the economy is a function of imported inputs (M_{Int}) and domestic value added (Y). The latter is generated by labor L and the aggregate capital stock J (equation 2).[4] Following Marquez (1984 and 1985) and Michalopoulos (1975), a distinction is made between a domestically produced capital stock (K_d) and an imported one (K_f) which combine to form the aggregate J (equation 3). Both parts of the production function system which incorporate an imported input are described by constant-elasticity of substitution functions (equations 1 and 3) while the domestic value added function (equation 2) is assumed to be of a Cobb-Douglas type.[5]

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4 The aggregate capital stock corresponds to Sato's (1967,1975) efficiency capital stock.

5 Data on average man-hour employment in Ecuador could not be obtained. Therefore the elasticity of substitution between the aggregate capital stock and labor had to be restricted to one. Studies examining the functional relationship between capital and labor in developing countries generally find substantial substitution possibilities in most industries, often close to unity. Compare Laumas and Williams (1981), Morawetz (1976) and Sines (1979).

Box 1: Model functions and variable definitions

Aggregate Production

(1) $Q = Q_{CES}\{Y, M_{Int}, t\}$
(2) $Y = Y_{CD}\{J, L, t\}$
(3) $J = J_{CES}\{K_d, K_f, t\}$

Derived factor demands (cost minimization)

(4) $M_{Int} = M_{Int}\{Y, P_Y, P_{MInt}E(1+t_{MInt}), t\}$
(5) $K_d = K_d\{Y, P_{MCap}E(1+t_{MCap}), P_Q, w, t\}$
(6) $K_f = K_f\{Y, P_{MCap}E(1+t_{MCap}), P_Q, w, t\}$

Cost functions (mark-up pricing)

(7) $P_Q = P_Q\{P_{MInt}E(1+t_{MInt}), P_Y, t\}$
(8) $P_Y = P_Y\{P_J, w, t\}$

Other imports

(9) $M_{Oth} = M_{Oth}\{Y, P_{MOth}E(1+t_{MOth}), P_Q\}$

Export supply and demand

(10) $X_S = X_S\{Q, P_Q, P_XE\}$
(11) $X_D = X_D\{Y_W, P_WE, P_XE\}$
(12) $X = X_D = X_S$

Definitions

(13) $P_J = P_J\{P_Q, P_{MCap}E(1+t_{MCap}), t\}$
(14) $M_{Cap} = M_{Cap}\{dKf, \Theta\}$
(15) $MV = \{P_{MCap}M_{Cap} + P_{MInt}M_{Int} + P_{MOth}M_{Oth}\}/E_B$
(16) $XV = \{P_X X\}/E_B$
(17) $TB = XV - MV$

Functions and depreciation parameter

CES	Const. Elasticity of Substitution
CD	Cobb-Douglas
Θ	depreciation rate (12.5%)

Variables

E	nom. exchange rate, Suc. per $
E_B	exchange rate, base year value
J	aggr. capital stock (const. Suc.)
K_d	dom. capital stock (const. Suc.)
K_f	imp. capital stock (const. Suc.)
L	labor
M_{Cap}	imp. capital goods (const. Suc.)
M_{Int}	imp. intermediates (const. Suc.)
M_{Oth}	other imports (const. Suc.)
MV	total import value ($)
P_J	price of efficiency capital stock
P_{MCap}	price of M_{Cap} and of K_f ($)
P_{MInt}	price index of M_{Int} ($)
P_{MOth}	price index of M_{Oth} ($)
P_Y	price index of Y (Suc.)
P_Q	price index of Q and of K_d (Suc)
P_X	export price index ($)
P_W	OECD price index ($)
Q	domestic output (const. Suc.)
t	time index (tech. progress)
TB	trade balance ($)
t_{MInt}	implicit import tax on M_{Int}
t_{MCap}	implicit import tax on M_{Cap}
t_{MOth}	implicit import tax on M_{Oth}
w	wage rate index (Suc.)
X_S	export supply (const. Suc.)
X_D	export demand (const. Suc.)
XV	export value ($)
Y	dom. GDP (const. Suc.)
Y_W	OECD GDP (const. Suc.)

Under the assumption that firms minimize costs of production subject to a given output constraint, derived demand curves for imported intermediate goods and the two capital stocks can be determined from the production function system (equations 4 to 6). We derive the cost functions corresponding to the production functions which allows us to endogenize two relevant domestic prices, namely the ones of gross output (P_Q) and value added (P_Y) (equations 7 and 8). The effect of price changes of imported inputs on the domestic price level of value added and gross output, which reduce the real impact of nominal exchange rate devaluations, can hence be assessed. It should be pointed out that the price rise stems solely from the supply-push effect and that it does not mirror shifts in the composition and level of aggregate demand or monetary assets.

We assume Ecuador to be small on the import side so that import prices are determined exogenously. Imports of intermediate goods are directly determined from the derived factor demand function while imports of capital goods are deduced from the change in the stock of imported machinery, taking into account depreciation on past investment (14).[6] The residual import category ('other imports') consists mainly of consumer goods and constitutes a minor share in total imports. Demand for these goods is modelled as a function of domestic income and the relative price between this type of imports and the home-made goods (9).

Product differentiation is introduced on the export side. An export supply function is incorporated while staying within the framework of a one-sector economy (Melo and Robinson 1989). In contrast to the import side, the export price is not assumed to be determined exogenously which might seem to be an unusual assumption for a small country. However, for coffee and bananas (which constitute Ecuador's main exports besides oil), consumers tend to differentiate products by origin. As we assume a one-good economy, export demand is not product specific. Instead it is depicted as a function of the relative price between Ecuadoran products and the OECD price deflator on the one hand, and OECD real income level on the other. The export market is depicted by equations 10 to 12.

Distribution parameter and long-run elasticity estimates from non-linear simultaneous estimations are summarized in Table 2.[7] Focus rests with the estimates

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6 Capital stocks are calculated by inventory method assuming a depreciation rate of 12.5%. A relatively wide dispersion of rates for developing countries are put to use in the literature. E.g., while Bergsten et al. (1985) assume an average rate of 20%, Kell and Marchese (1991) employ a 12.5% rate as used in this study. Field (1987, p.1285) and Ikemoto (1986, p.387) apply a rate of 10%, while the IMF (1989, p.66) posits a rate of 5%.

7 Estimations are carried out in several blocks: Block A: the demand for intermediate inputs (M_{Int}) and the output price (P_Q); Block B: demand for the two capital stocks and the GDP price deflator (P_Y); Block C: export supply and demand (X_D and P_X). The demand for other imports (M_{Oth}) is estimated with OLS.

of the elasticities of substitution for imported factors of production. Imported intermediate goods and domestic value added are found to be complements; the estimate of the elasticity of substitution between these two factors is 0.57. Price

Table 2: Selected elasticity and parameter estimates

	value	t-value	restriction in simulation
Long-run elasticities (1973-1987)			
in production:			
substitution between M_{Int} and Y	.57	3.4	
substitution between K_D and K_F	.12	.39	= 0
in demand and supply:			
price elasticity of M_{Oth}	-.77	3.0	
income elasticity of M_{Oth}	1.14	3.7	
price elasticity of X_D	-.61	4.0	
income elasticity of X_D	.76	3.1	
output elasticity of X_S	.87	1.9	
price elasticity of X_S	.15	.50	= 0
distribution parameters (1973-1987)			
relating to Y in equation 1	.98	49.0	
relating to J equation 2	.71	10.1	
relating to K_d equation 3	.64	6.4	

changes do affect factor-input relations. As the estimate is significantly different from 0 and 1, the general CES formulation can neither be approximated by a fixed-proportion nor a Cobb-Douglas function.[8] Substitutability between the two capital stocks is significantly weaker.[9] The estimate has the expected positive sign but is

8 Other studies estimating the elasticity of substitution between imported intermediate goods and domestic factors of production also describe these factor pairs as complements. Conway (1986), exploring the same relationship as depicted above for Turkey, attains an estimate of 0.66; Marquez (1984) and Marquez and Pauly (1987) compute a long-run estimate of the elasticity of substitution between imported oil and the domestic capital stock (for the developing countries as a group) of 0.73.

9 We assume replacement costs of new investments to represent the relevant user cost of the capital stocks.

small and insignificant. According to these results, changes in user costs do not influence the composition of the aggregate capital stock. As on offspring, the corresponding CES function can be approximated by a fixed-proportion function between the imported and domestically produced capital stock. The crucial role imported capital goods play in the Ecuadoran economy is further strengthened by the magnitude of the distribution parameter. The long-run share of the domestic capital stock (K_d) in the aggregate capital stock (J) is estimated at 64%, hence the imported capital stock (K_f) contributes 36% to J. Also, the aggregate capital stock J is the major contributor in generating domestic value added.

Turning to the other estimates, the demand for other imports (M_{Oth}), which mainly consist of consumer goods, is income-elastic and price-inelastic. Demand for Ecuador's exports (X_D) is both price- and income-inelastic which could be expected since they consist mainly of agricultural and oil products. In this crude, non-disaggregate form of depicting the export market, no significant response of export supply (X_S) to price incentives could be deduced. The export quantity is driven solely by supply capacity. This result has to be interpreted with care. First, a significant share of Ecuadoran exports was dominated by commodity agreements during part of the estimation period (OPEC, International Coffee Agreement) which limited the response of export supply to price changes. Second, individual export categories might show a price responsiveness which does not show on an aggregate level. Third, domestic policies and institutional factors influencing price and adjustment times are not included in the above estimation. The crude form of depicting the export market should therefore be kept in mind when we look at the simulations.

Considering the above results, the low substitution elasticities for imported means of production imply a limited flexibility of the Ecuadoran economy. The elasticities result from resource endowments and the stage of development but also from the trade and industrial policy orientation. The elasticities should consequently not be viewed as constants. Policies that are conducive to the efficient use and development of domestic resources (which lead to, e.g., the domestic accumulation of skills, technological developments and factor mobility) positively influence the price responsiveness of export supply and import demand.

4. Simulation

The model is used to examine how the trade balance (measured in current dollars) reacts to variations in the growth path of several exogenous variables, namely domestic and world GDP, import prices and the exchange rate.[10] The calculations

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10 The model contains eight endogenous variables: the prices of domestic GDP (P_Y), domestic output (P_Q) and exports (P_X), imports of intermediate (M_{Int}) and other goods (M_{Oth}), exports (continued...)

are not designed to forecast endogenous variables but rather to see how the structural importance of imports (combined with the export specification) translates itself into trade balance reactions. Although the Ecuadoran supply-side specification contains a fixed-proportion production function linking the domestically produced and imported capital stocks, substitution possibilities for both imported factors of production are present in the model: labor and intermediate inputs can be employed to replace the capital stock from imports (K_f) and both types of capital stocks as well as labor substitute for intermediate inputs.

The computations are conducted in the following way: In the base scenario, import prices, tariffs, the domestic wage, and the exchange rate are kept constant. OECD income is raised by 2% over the following periods and so is the world price deflator. Domestic income is assumed to grow by 3%. Average five-period values of the three import quantities (M_{Cap}, M_{Int}, M_{Oth}), export volume (X_Q), and the three endogenous prices (P_Q, P_Y, P_X) are then computed, excluding the first period (in which changes are introduced in the other scenarios). In Table 3, the first column contains indices of these variables (set at 1.0 in the base scenario) as well as the resulting values of exports, imports and the trade balance (in current dollars).

The first variation studies the effects of a nominal devaluation of 15% with the exchange rate kept at this level thereafter; the other exogenous variables remain as in the base scenario.[11] The rise in the exchange rate causes an increase in the local currency price of imported capital and intermediate goods. The higher relative price between imports and their domestic substitutes reduces demand for all three import categories, but to a different degree. The smallest reduction occurs (as expected) for imported capital goods since substitution possibilities are limited.[12] Imports of machinery and equipment are estimated to fall short of their base case volume by 1.4% only. A somewhat higher degree of substitutability is associated with imports of intermediate inputs, whose import quantity is calculated to decline by 5.4% in response to the devaluation. The category of imports affected most is 'other goods',

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10(...continued)
(X) and the two capital stocks (K_d and K_f). Subjecting the model to ex post simulation (1973-1987) produces satisfactory results. The endogenous variables all show high correlations with the historical time series and the Theil inequality coefficient is below 5% in all cases except for the generated time series of the export price.

11 The nominal wage rate is also kept as in the base case since no feed back mechanism between a change in the price of gross output and the nominal wage is included.

12 Adjustment lags are included in the estimation which contributes to the low response of imports to changing prices. The mean lag for the adjustment of quantities ranges from half a year (intermediate imports), 2 years (exports), 4 years (imported capital stock) to 10 years (domestic capital stock). The adjustment time of prices (P_X, P_Y, P_Q) is estimated to be significantly shorter and almost instantaneous.

being largely consumer articles. Imports of this category decrease by 7.6% in response to the 15% nominal devaluation. The effect is not higher since the import price increase (in domestic currency) pushes up the GDP-price deflator (P_Y) by an average of 4.4% and the gross output price by 5.1%, so that the 15% nominal devaluation is translated into a 10% 'real' devaluation.[13]

Table 3: Simulation results for domestic GDP growth of 3% [1]

Variable	base (1)	devaluation (2)	tot decline (3)	OECD growth (4)
P_Y	1.000	1.044	1.058	1.000
P_Q	1.000	1.051	1.068	1.000
P_X	1.000	1.009	1.010	1.062
X_Q	1.000	.995	.994	1.000
M_{Int}	1.000	.946	.931	1.000
M_{Cap}	1.000	.986	.982	1.000
M_{Oth}	1.000	.924	.908	1.000
XV	2600	2609	2610	2762
MV	1940	1836	2167	1940
TB	660	773	443	822

1 Indices (solution of the 'base simulation is set to 1); for the value of exports (XV), the value of imports (MV), and the trade balance (TB) current US dollars. Entries represent five-period average values (the year in which the variation is introduced is not taken into account).

Export supply is affected only marginally due to its sole dependence on gross output of the economy. Since GDP is assumed to grow as in the base case and imported intermediate goods decline, gross output of the economy falls marginally

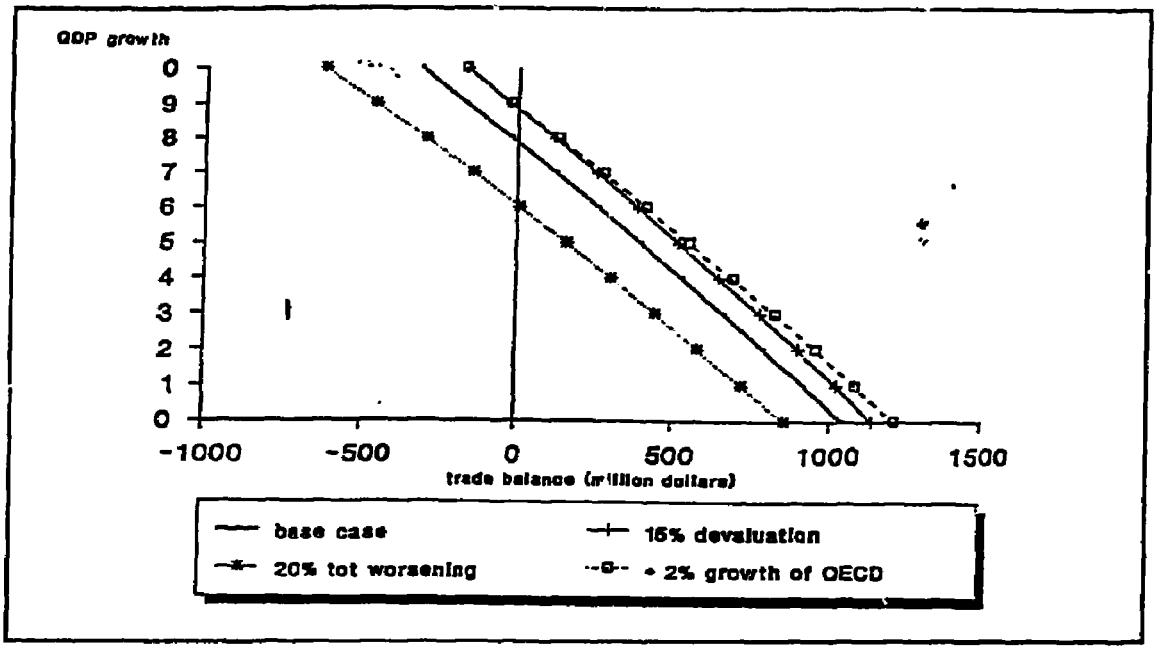
13 The term 'real' devaluation only refers to the net impact of the nominal devaluation and the domestic price rise (P_Q). It does not take inflation abroad into account.

compared to the base run. The same is observed for exports. The total import value decreases by slightly more than 5% which translates (with basically constant export quantity and export unit value) into a rather small improvement of the trade balance.

The second variation inspects the outcome of a once and for all increase in import prices by 20% The results are reported in the third column of Table 2. Quantities of all import categories are suppressed below the level experienced when examining the effect of the devaluation, since the import price rise causes a more pronounced change in the relative prices between imported and domestic goods. Most striking is again the small variation of capital goods imports, which are calculated to fall short of the base-run value by only 1.8%. The supply-inflationary effect drives up the price of value added by 5.8% and of gross output by 6.8%. Export quantity and price show little reaction again. The import price rise increases the import bill substantially, since the major import categories (intermediate and capital goods) respond only little. The trade balance deteriorates strongly by 30% as compared to the base scenario.

Finally, the third variation (column 4 in Table 3) concerns the impact of higher OECD growth rates on the Ecuadoran trade balance. The import side and domestic prices are not altered in relation to the base case. As export supply is independent of prices, export quantities do not respond to the higher world demand and lead to an increase in line with the base projection due to the capacity effect. The entire impact of higher world growth is transmitted to a rise of the export unit value by 6.2%. The trade balance is activated by about 150 million dollars.

Graph 1: Simulating trade balance reactions



Using these scenarios but varying the growth of domestic income produces a relationship between the trade balance and the domestic growth rate as depicted in Graph 1. By far the largest alteration of the growth-trade balance link occurs in the case of a terms of trade deterioration, specified as a 20% rise in import prices. Correspondingly, the positive effect of a 15% devaluation on the trade balance is relatively small. Although the empirical examination of the export side could not establish a link between the export quantity and world demand, the upward pressure on the export unit value index is sufficient to raise export revenues more than if the devaluation occurs.

Due to the limited price flexibility on both the export and import side of our model, traded quantities react only slowly. A terms of trade shock therefore causes an immediate and relatively high deterioration of the trade balance while a devaluation of a similar magnitude stimulates only a comparatively moderate improvement. These reactions are independent of the growth scenario. Hence, if a certain improvement of the trade balance is to take place without deflating the economy, large relative price changes via devaluations are necessary. Domestic supply-push inflation eroding these nominal devaluations, however, have to be taken into account when pursuing this policy.

5. Conclusion

This paper studied the linkages between trade and growth in the Ecuadoran economy, examining especially the connection between imported factors of production and output capacity. Import demands for capital and intermediate goods were derived from a macroeconomic production function assuming that economic agents minimize costs for a given output. Estimations showed that the elasticity of substitution between Ecuadoran capital goods and imported machinery was limited for the 1972-1987 period -- a result which is intuitive as the machinery producing sector in Ecuador was (and still is) in its infancy. Relative price changes influenced the demand for intermediate imports to a higher degree, although we determined domestic value added and intermediate inputs to have been complements in production both in the short and long run. In part, these elasticities reflect the policy environment which was heavily biased against labor and in favor of imported capital goods during the 1970s.

In combination with an undiversified export base, the low trade elasticities on the import side characterized the Ecuadoran economy as vulnerable to external shocks during the 1980s. To examine this vulnerability, we incorporated the import elasticities (jointly with a simultaneous specification of export demand and supply) in a simple supply-side model. Simulations showed that a 15% devaluation improved the trade balance but that this improvement was modest due to the low trade elasticities and due to supply-push inflation which eroded the initial nominal devaluation. Similarly, a terms-of-trade deterioration had a pronounced negative impact on the trade balance. To the extent that trade elasticities remain to be low in the 1990s, events such as a commodity price decline, a renewed credit squeeze or increased protectionism against Ecuadoran exports - like the recent EC quotas on banana imports - can translate themselves into renewed domestic supply disturbances. Policies that lead to a diversification of exports and a higher price responsiveness on the import side would reduce the vulnerability of the Ecuadoran economy to external shocks.

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Annex: Data sources

The domestic capital stock (K_d) is computed by inventory method (depreciation rate 12.5%) from real gross investment figures (net of imported capital goods) from the World Tables of the World Bank. The imported capital stock (K_f) is calculated by the same method from imports of capital goods (M_{Cap}). All trade data, prices and classifications stem from the United Nations Comtrade database and the UNCTAD database on price deflators. The definition of capital and intermediate goods follows

United Nations (1971). Other price deflators are taken from UNIDO (gross output deflator), World Bank (GDP deflator) and OECD (OECD deflator).

The structure of nominal charge rates for the three different import categories can be computed for 1987 from the Tariff Information System of UNCTAD. Each charge rate is weighted with the import composition of all developing countries in order to mitigate the effect that high charges reduce imports. The *structure* of the charge rates is assumed constant - the relationship between t_{Int}, t_{Cap} and t_{Oth} - is constant over the period of estimation (1973 to 1987). This does not imply, however, that the protectionist effect on each import category itself remained constant. Rather, its is assumed that tariff and non-tariff barriers were raised and lowered on all import categories alike, so that the relation between the protectionistic effects on the different import categories remained stable. Implicit average import taxes are then estimated using data on tax revenues form imports which are supplied by the IMF. The implicit tax is defined as the ratio of the government revenue from imports and the nominal import bill. Application of the structure of nominal charges to import and revenue data enables the computation of implicit average tax rates for each import category separately.

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